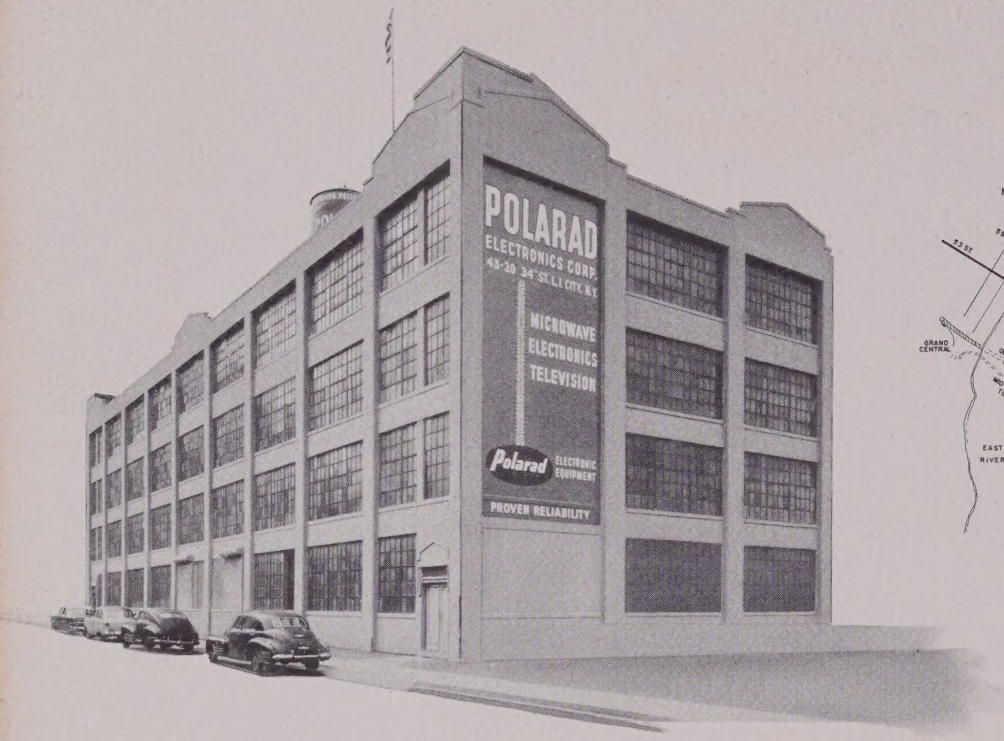
POLARAD

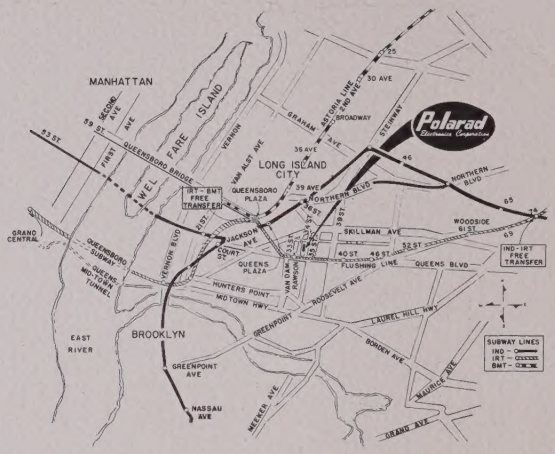
PROVEN RELIABILITY

HANDBOOK
OF
OPERATING INSTRUCTIONS

MULTIPULSE GENERATOR MODEL MP-1A

POLARAD ELECTRONICS CORPORATION, 43-20 34th STREET, LONG ISLAND CITY 1, N.Y.





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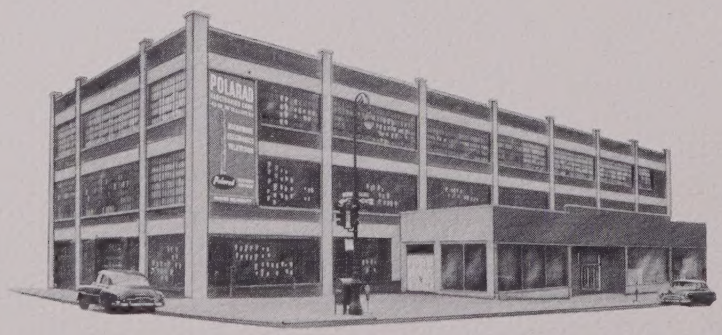

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INSTRUCTION MANUAL

MULTIPULSE GENERATOR MODEL MP-1A

POLARAD ELECTRONICS CORPORATION

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Warranty

Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Eectronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.

Polarad
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INSTRUCTION MANUAL
MODEL MP-1A
MULTIPULSE GENERATOR

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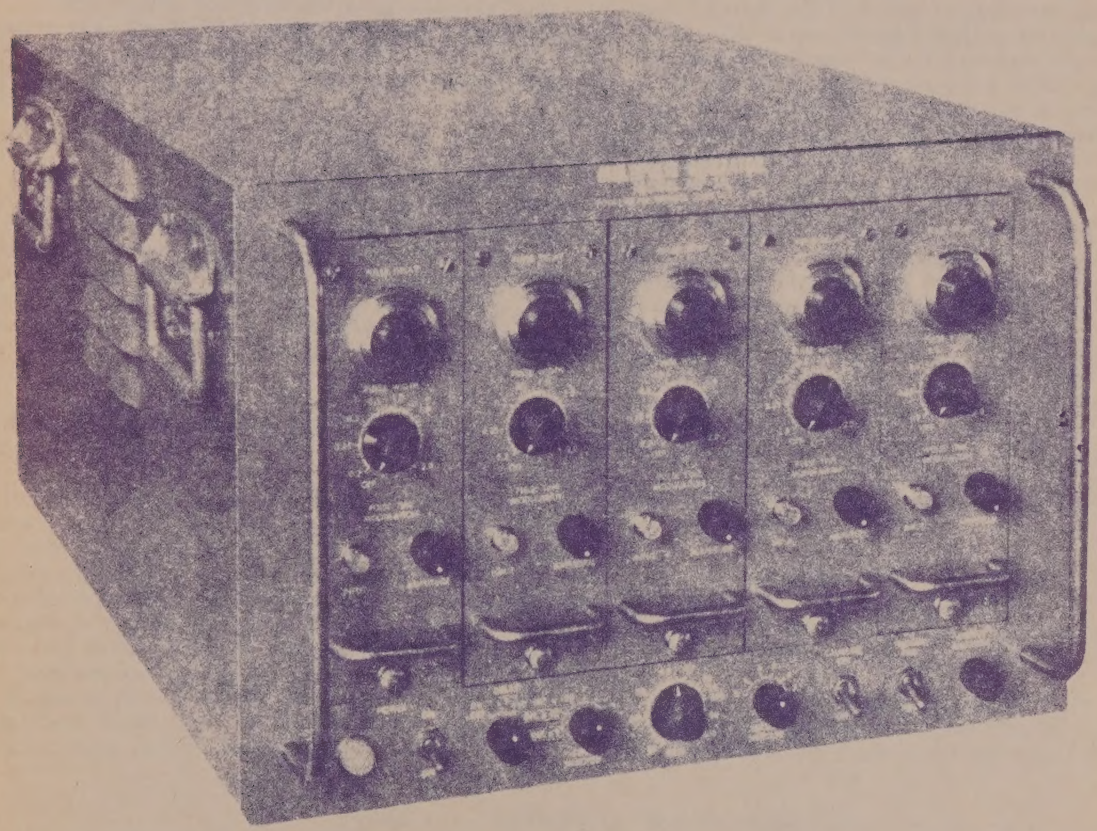


Figure 1. Multipulse Generator Model MP-1A.

MODEL MP-1A

MULTIPULSE GENERATOR

SECTION 1

DESCRIPTION AND LEADING PARTICULARS

1-1. INTRODUCTION

This manual provides operating and servicing instructions for the Multipulse Generator, Model MP-1A. This unit is designed, developed and produced by the Polarad Electronics Corporation, Long Island City, New York.

This manual consists of four sections. Section 1 describes the equipment, covering its physical and electrical characteristics. Section 2 discusses the theory of operation. Section 3 provides operating and installation instructions. Section 4 presents the service and maintenance procedures.

1-2. PURPOSE OF THE EQUIPMENT

The Multipulse Generator is a precision instrument which provides a train of from one to five pulses for use in checking missile, beacon, and other interrogation systems. Any one, or all five pulses, may be pulse-time modulated. Each pulse is independently adjustable in width and time, and the entire train of from one to five pulses is simultaneously adjustable in amplitude and repetition rate. Thus, any number of pulses up to five may be obtained with controlled amplitude, width, spacing, and repetition rate to meet specific coding requirements.

1-3. DESCRIPTION

The equipment consists of a cabinet-enclosed main chassis and five plug-in pulse and generator units. The main chassis contains the rate and synchronizing generator (which provides continuously variable rate triggers from 10 to 10,000 pps), the pulse output stage (which mixes and shapes the individual pulse generator unit outputs to provide a train of pulse groups consisting of from one to five pulses), and the power supplies required to operate the unit.

The plug-in pulse and delay generators are identical units. Each unit consists of a delay generator, pulse generator and a mixer-inverter. These circuits provide a pulse which is variable in width and time by means of two controls mounted on the front panel. The units are secured to the main chassis by means of a Dzus fastener so that the front panels of the pulse and delay generator units and the main chassis front panel lie in the same plane. The main chassis circuitry is designed so that the equipment will operate with any of the plug-in pulse generator units removed. This enables the operator to service the plug-in units without turning off the equipment.

All required accessory cables are provided with the equipment. The unit is shipped ready for operation (after output is terminated with a suitable resistance) with tubes, fuses and indicators in place.

Table 1-1 lists the technical characteristics of the equipment. Table 1-2 shows the tube complement. Table 1-3 is a list of the fuses and lamps provided.

TABLE 1-1. TECHNICAL CHARACTERISTICS

Power Source	105 to 125 volts, 50/60 cps, single phase ac
Outputs	Single pulse, multipulse, or square wave (internal or external modulation).
Internal Pulse	a. Repetition rate is variable from 10 to 10,000 pulse groups per second. b. Five independently adjustable pulse channels. Pulse width continuously adjustable from 0.2 to 2 microseconds. Each pulse is capable of being independently adjusted in time from 0 to 30 and 0 to 300 microseconds. c. Zero time (X1) occurs approximately 2 microseconds after the sync pulse. Interaction between pulses is minimized to a point where pulses can be adjusted within 0.1 microsecond, trailing edge to leading edge.
Pulse Time Modulation	Each pulse is separately modulated by an external modulating voltage. Characteristics required may vary from 1 to 2 volts rms per microsecond, depending upon the delay setting, with a frequency range within the limits of 40-400 cps. Deviation may be varied by means of a gain control on the panel.

TABLE 1-1. TECHNICAL CHARACTERISTICS (cont)

Square Wave	a. Repetition rate is variable from 10 to 10,000 cycles per second. b. Output impedance is 22K. Peak-to-peak amplitude is 35 volts.
Trigger Pulse	a. At zero time, or simultaneous with any of the output pulses. b. Pulse amplitude 10 volts positive or negative minimum, delivered into a 75-ohm load.
External Sync Required	Pulse: a. Positive or negative polarity. b. 5 to 25 volts peak-to-peak. Pulse width 0.2 to 20 microseconds. Sine Wave: a. 10 volts peak-to-peak, minimum. b. 10 to 10,000 cycles per second.
Output Pulse	a. Rise Time: Better than 0.06 microsecond, as measured between 10 and 90% of maximum amplitude of initial rise. b. Decay Time: Less than 0.06 microsecond, as measured between 10 and 90% of maximum amplitude of the final decay. c. Overshoot: Less than 10% of maximum amplitude of the initial rise. d. Amplitude: 20 volts minimum into 100 ohms.
Delay	a. Calibration: From 2 to 32 and 20 to 320 microseconds. b. Delay Jitter: 3 milliseconds maximum. (for 30 microseconds delay range only) c. Individual control for each pulse channel.
Overall Dimensions	19-1/2 inches wide by 12 inches high by 24 inches deep.
Weight	135 pounds.

TABLE 1-2. TUBE COMPLEMENT

Modulator Power Supply		
Symbol No.	Tube No.	Function
V101	5R4GY	Rectifier
V102	5R4GY	Rectifier
V103	6X4	Bias Rectifier
V104	6336	Series Voltage Regulator
V105	6336	Series Voltage Regulator
V106	6AU6	Voltage Control Amplifier
V107	5651	Voltage Reference
V108	12AT7	Blocking Oscillator
V109	6CL6	Clipper Amplifier
V110	6CL6	Cathode Follower
V111	6CL6	Cathode Follower
Modulator Driver		
V201	5751	Rate Generator
V202	12AT7	Schmidt Multivibrator
V203	12AT7	Trigger Amplifier
V204	6J6	Gate Generator
V205	6J6	Sawtooth Generator
V206	12AT7	Square Wave Output Cathode Follower
V207	12AT7	1-Mc Oscillator and Keyer
V208	6AU6	Blocking Oscillator
V209	6J6	Cathode Follower
Pulse Generator (Five identical [illegible] Supplied)		
V301	12AU7	Voltage Comparator
V301	12AU7	Voltage Comparator
V302	6AH6	Width Multivibrator
V303	6AH6	Width Multivibrator
V304	6CL6	Mixer-Inverter

TABLE 1-3. FUSE AND INDICATOR LAMP COMPLEMENT

Symbol	Characteristic
F101	5A-250 v 3 AG (Littelfuse)
F102	5A-250 v 3 AG (Littelfuse)
F103	1/2A-250 v 3 AG (Littelfuse)
Indicator	Type and Use
I 1	NE-51 White, POWER on

SECTION 2

THEORY OF OPERATION

2-1. GENERAL

a. The Model MP-1A Multipulse Generator is a self-contained modulator unit with five plug-in pulse- and delay generator units. The modulator provides the following:

(1) Five independently controlled pulse and delay generators.

(2) Square wave output, continuously variable in frequency from 10 to 10,000 pps.

(3) One set of calibrating time markers, 1.0 microsecond.

(4) Positive or negative external sync pulses.

b. Figure 5 is a block diagram of the Multipulse Generator. To help in understanding the operation of the unit, actual waveforms have been included at all important points. (Refer to figure 4 for the overall schematic diagram.)

c. The Multipulse Generator consists of four basic sections:

(1) A driver-sawtooth generator and square wave generator.

(2) A pulse and delay generator.

(3) A time marker generator.

(4) An output circuit.

Each section contributes to the overall operation of the unit, but is considered separately for purposes of circuit discussion in paragraphs 2-2 through 2-13. below.

2-2. RATE GENERATOR

The rate generator, tube V201, is a standard square wave generator. The rate of this symmetrical multivibrator is set by the resistors and capacitors placed into the circuit by the operation of the SYNC SELECTOR switch (S201) and the RATE potentiometer (R204). When the SYNC SELECTOR switch is in the INT. X1 position, one set of capacitors is connected to the circuit which allows the RATE potentiometer to vary the resistance of the R-C combination to produce a pulse repetition rate that may be varied from 10 to 100 cps. In the INT. X10 position, a second group of capacitors is utilized, which multiplies the pulse repetition rate by ten, permitting the RATE potentiometer to vary the output from 100 to 1000 cps. In the INT. X100 position, a third group of capacitors is utilized, which multiply the pulse repetition rate by one hundred, permitting the RATE potentiometer to vary the output from 1000 to 10,000 cps. When the SYNC SELECTOR is in the sine position ( ), the stage acts as an amplifier with a sine-wave output.

2-3. SCHMIDT MULTIVIBRATOR

The Schmidt multivibrator V202 receives the signal from the rate generator and acts to sharpen and square the waveform so that the output of this stage is a clean, sharp square wave with constant amplitude. The square wave is also differentiated. This differentiated output, in the form of a negative trigger, is fed via the SYNC SELECTOR switch to the trigger amplifier, tube V203.

2-4. TRIGGER AMPLIFIER

The trigger amplifier, tube V203, is used to supply a positive trigger to the gate generator, tube V204. The positive trigger is obtained by the action of crystal CR202, which clips the negative portion of the pulses.

2-5. GATE GENERATOR

In X1 position, gate generator V204 produces a 40 usec gate, and in X10 position produces a 400 usec gate. The output of this tube triggers the sawtooth generator, tube V205, and the 1-mc keyer section of tube V207, which is part of the time marker circuit.

2-6. SAWTOOTH GENERATOR

Tubes V205 and V209 comprise the sawtooth generator section of the unit. The output from the gate generator is used to trigger V205 to generate a sawtooth output, which is synchronized with the gated output. The sawtooth generator is coupled to cathode follower V209, to provide a low impedance output to the five plug-in pulse and delay generators. The output of the cathode follower is fed back to charging resistor R229 to linearize the sawtooth.

2-7. PLUG-IN PULSE AND DELAY GENERATORS

The unit accommodates five independent plug-in pulse and delay generator chassis. Each plug-in unit consists of a voltage comparator (delay generator) made up of two tubes, V300 and V301, a pulse generator (multivibrator) made up of two tubes, V302 and V303, and a mixer-inverter, tube V304.

2-8. VOLTAGE COMPARATOR

The voltage comparator, tubes V300 and V301, is a multivibrator which is triggered by the sawtooth output from the cathode follower, V209, and the d-c level, which may be adjusted by means of the DELAY potentiometer (R303). The minimum delay limit is set by R309, which is a screwdriver adjustment. DELAY potentiometer R303 permits the trigger delay of each plug-in unit to be varied continuously from 2 to 32 microseconds or from 20 to 320 microseconds. The pulse delay of each plug-in unit is therefore independent of the settings in any other plug-in chassis. For pulse time modulation, the modulating signal is added to the dc level set by the DELAY potentiometer R309.

2-9. PULSE GENERATOR

Two tubes in each plug-in unit, V302 and V303, function as a multivibrator to generate the pulses. The delayed trigger from V300 and V301 is applied to the multivibrator, which generates the delayed pulses in synchronism with the input trigger. The delayed pulse may then be controlled so that its duration can be continuously adjusted between 0.2 and 2.0 microseconds by means of the PULSE WIDTH potentiometer (R312). The maximum pulse width can be adjusted by means of R322, a screwdriver adjustment. A switch, which is part of the PULSE WIDTH potentiometer, permits each individual plug-in unit to be turned on or off, in order to select the desired number of pulses.

2-10. MIXER-INVERTER

The delayed pulse is fed to the mixer-inverter, tube V304, which is negatively biased. One of the two outputs of this tube (in each of the plug-in generators) is differentiated and conducted to one of the available positions on the TRIGGER SELECTOR switch. The TRIGGER SELECTOR switch is wired so that the "O" position selects the trigger pulse from the gate generator (V204) and each of the remaining five positions is connected to its respective plug-in unit; (that is, position one is connected to plug-in number one; position two is connected to plug-in unit number two; and so forth). The TRIGGER SELECTOR switch thus selects the trigger which may be applied to an external oscilloscope, so that the width and delay of each pulse can be accurately set.

The second (pulse) output from each of the five mixer-inverters appears across common plate load resistor R136. Since the outputs of all five individual plug-in units are applied to R136 as a common plate load resistor, the output pulses are mixed to produce the number and type of pulses selected as a common output signal. This signal, in turn, is fed to the output circuit.

2-11. OUTPUT CIRCUIT

The output circuit of the unit consists of clipper amplifier V109 and cathode followers V110 and V111. V109 amplifies the mixed output pulses from the five pulse generator units and clips them so that each pulse is flat and of equal amplitude. AMPLITUDE control R143 is in the grid circuit of V109. Cathode followers V110 and V111 provide a low-impedance output, which must be terminated by 100-ohms.

2-12. TIME MARKER CIRCUITS

The time marker generators consist of tubes V207 and V208. One half of V207 functions as a 1-mc keyer to gate the other half of the same tube, which functions as a 1-mc oscillator. Since one megacycle is exactly one pulse per microsecond, the output of this oscillator is controlled by varying the 1-usec adjustment C211, to provide a 1-usec gated trigger to blocking oscillator V208. The 1-usec calibration pulse output of tube V208 is used to produce the 1-usec intensity-modulated calibration markers which are applied to the external crt, when the CALIBRATE switch is in the ON position.

2-13. 60-SECOND TIME DELAY RELAY

A 60-second time delay relay (K101) is included in the primary power supply circuit. It allows a warm-up period for the heaters of all tubes before application of plate voltage.

SECTION 3

INSTALLATION AND OPERATION

3-1. INSTALLATION

The Polarad Model MP-1A Multipulse Generator is complete in one unit and is ready for use upon delivery. No permanent or special installation procedures are required. No special procedure is required for setting up the unit prior to operating it, other than its connection to a suitable 105 to 125 volts, 50/60 cycles, single phase alternating current source.

3-2. OPERATION

a. Function of Controls. Table 3-1 lists the panel designations of operating controls, indicators, connectors, and their functions.

b. Control Settings. Control settings vary, depending upon the type of output desired. By referring to Table 3-1 and the equipment front panel markings, any desired type of operation may be setup and utilized. See figures 1 and 2 for location of pulse controls.

Figure 2. Typical Plug-in Pulse and Delay Generator Unit, Front View

TABLE 3-1. OPERATING CONTROLS AND CONNECTORS

Control, Indicator, or Connector	Location	Function
POWER indicator	Lower left of panel	White-lens indicator; glows when ac is applied to modulator filament transformer.
POWER ON-OFF switch	Lower left of panel	Turns ac power on and off.
B+ OFF-X1-X10 DELAY	Lower left center of panel	Turns B+ off and switches into X1 and X10 delay positions.
SYNC SELECTOR	Lower left center of panel	This six-position switch is used to select the type of synchronizing signal applied to the modulator circuit.
INT. X1	SYNC SELECTOR position	In this switch position, the rate is set by the R-C constants of the internal rate generator circuit. The resistance is varied (by means of the RATE control on the front panel) to give a repetition rate of 10 to 100 pulses per second.
INT. X10	SYNC SELECTOR position	In this switch position, the rate is set by the R-C constants of the internal rate generator circuit. The resistance is varied (by means of the RATE control on the front panel) and a different set of capacitors is automatically switched into the circuit to give a repetition rate of 100 to 1000 pulses per second.
INT. X100	SYNC SELECTOR position	In this switch position, the rate is set by the R-C constants of the internal rate generator circuit. The resistance is varied (by means of the RATE control on the front panel) and a different set of capacitors is automatically switched into the circuit to give a repetition rate of 1000 to 10,000 pulses per second.
+ (Plus)	SYNC SELECTOR position	In the plus position, the internal gate and sawtooth generators are synchronized with positive polarity pulses from external equipment, with the signal applied to the SYNC INPUT jack in rear of unit.
- (Minus)	SYNC SELECTOR position	In the minus position, the internal gate and sawtooth generators are synchronized with negative polarity pulses from external equipment, with the signal applied to the SYNC INPUT jack in rear of unit.
~(Sine)	SYNC SELECTOR position	In the sine position, the rate generator may be synchronized with a sine wave sync signal from external equipment, with the signal applied to the SYNC INPUT jack in rear of unit.
SYNC INPUT	Rear of unit	This jack is used to accept an external signal which may be used to synchronize the modulator with a sine wave or pulse sync signal if desired. When the SYNC INPUT jack is used, the SYNC SELECTOR switch must be set to a position corresponding to the type signal applied.

TABLE 3-1. OPERATING CONTROLS AND CONNECTORS (cont)

Control, Indicator, or Connector	Location	Function
RATE	Lower center of panel	These potentiometers set the resistance values of the rate generator. They vary its R-C constants to give repetition rates varying from 10 to 10,000 cycles per second, when used in conjunction with the SYNC SELECTOR internal positions.
TRIGGER SELECTOR	Lower right center of panel	This switch selects the trigger which is fed to an external oscilloscope, to the TRIGGER POS-NEG switch, and to the front panel TRIGGER OUTPUT jack. The trigger developed by the driver circuitry or any trigger developed by each of the five plug-in pulse and delay generators, may be selected by this switch.
TRIGGER POS-NEG	Lower right of panel	This switch selects the polarity of the trigger, available at the TRIGGER OUTPUT jack.
TRIGGER OUTPUT	Rear of unit	This jack makes available the trigger selected by the TRIGGER SELECTOR and the TRIGGER POS-NEG switches.
CALIBRATE ON-OFF	Lower right center of panel	This switch, in its ON position, injects the one-microsecond calibration marker on to an external oscilloscope display for accurate calibration of pulse widths and spacing.
OUTPUT AMPLITUDE	Lower right of panel	This potentiometer sets the amplitude of the output pulses.
PULSE DELAY	Top section, each plug-in unit front panel	Each of the five plug-in units has a PULSE DELAY knob. This knob permits the continuous delay adjustment of each pulse, with a delay from zero to 30 microseconds with relation to time zero. NOTE Pulses may also be superimposed by proper adjustment and calibration procedures.
PULSE WIDTH	Center section, each plug-in unit front panel	This control permits the duration of each pulse to be independently and continuously adjusted from 0.2 to 2.0 microseconds.
PULSE TIME MODULATION INPUT jack	Left section, each plug-in unit front panel	Each pulse may be separately time-modulated by feeding an external modulating voltage into the INPUT jack. Modulation voltage required may vary from 1 to 2 volts rms, per microsecond, depending upon the delay setting, with a frequency range from 40 to 400 cps.
AMPLITUDE	Front panel, each plug-in unit front panel	The time deviation of the time-modulated pulse may be varied by means of this control. The maximum deviation is ±0.5 microsecond.

SECTION 4

MAINTENANCE

4-1. PRELIMINARY INSPECTION PROCEDURE

Preliminary inspection comprises a series of operations performed on the Multipulse Generator, while it is turned off, in an effort to correct conditions which might lead to a breakdown.

In the procedures listed in Table 4-1, maintenance personnel are instructed to look for dust, dirt, loose connections, or any other cause for possible breakdown. In addition, some signs of possible circuit failure, such as cracked, chipped or broken parts, indications of capacitor breakdown, evidenced by melted wax or leakage, discoloration of resistors, are listed.

NOTE

Extraordinary care has been taken in the design and manufacure of this unit. It has been laboratory tested and inspected under strict engineering supervision. All electrical components have been selected to operate well within prescribed manufacturing tolerances. Any indication of failure should be checked until the cause is located and corrected. The mechanical components have been designed for trouble-free operation for the life of the equipment and should not be tampered with unless a mechanical breakdown occurs.

In performing these inspections, it must be remembered that equipment failure may be prevented by thorough checking.

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE

What to Inspect	Defects	Remedies	Precautions
Dials, knobs, and switches.	Loose or jammed.	Check all function switches to see that they operate properly and do not slip or jam. Check all toggle switches to see that they are securely mounted and operating. Tighten set screws on knobs, where required. If any portion shows signs of evident wear, replace it.	
Pilot light.	Jewel cracked, broken or missing. Does not operate.	See that lamp is operating; replace burned out lamp; see that jewel is in place.	Check voltage and rating on schematic. See that jewel is as required.
(Internal) Wiring.	Loose wires.	Resolder, recable, or replace under clamps, as necessary.	
Solder joints.	Loose solder joints. Corroded joints.	Resolder. Clean and resolder.	
Resistor, capacitor and tube mounting boards.	Loose mounting.	Tighten mounting screws and nuts.	
Resistors.	Cracked, chipping, blistering, discoloration and other signs of overheating.	Replace resistors.	If badly discolored, check value on schematic. Do not depend on color code.

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE (cont)

What to inspect	Defects	Remedies	Procedures
Capacitors.	Leaks, bulges, discoloration.	Replace capacitor.	
	Loose mounting bracket.	Tighten nuts holding bracket.	
Function switches.	Bent contacts, broken contacts.	Rebend with tweezers. Replace contacts or the entire switch.	
	Dirty or corroded contacts.	Clean with lint-free cloth moistened with approved cleaning solvent.	
All tubes and relays.	Poor seating.	Press tubes firmly into sockets.	Never work on tubes immediately after shut-down. Severe burns may result. Never jiggle tubes or partially withdraw them from sockets, as this weakens or breaks tube pins or loosens socket connections.
All tube shields.	Looseness.	Press into position.	
	Missing shields on tubes requiring shields.	Replace.	
Tube sockets.	Looseness.	Tighten mounting screws.	
	Cracks or chips.	Replace sockets, if necessary.	
	Dirty.	Clean with an approved solvent.	
Cables and power cord.	Broken, frayed, loose, kinks in cable, cuts or loose connections.	Check and tighten all connectors. Replace obviously worn cables or wiring.	Make sure that proper type of cabling and proper lengths are used.

4-2. TROUBLE SHOOTING

Table 4-2 lists trouble symptoms and corrective measures as an aid in localizing a defect to a particular circuit. See figure 3 for location of adjustments.

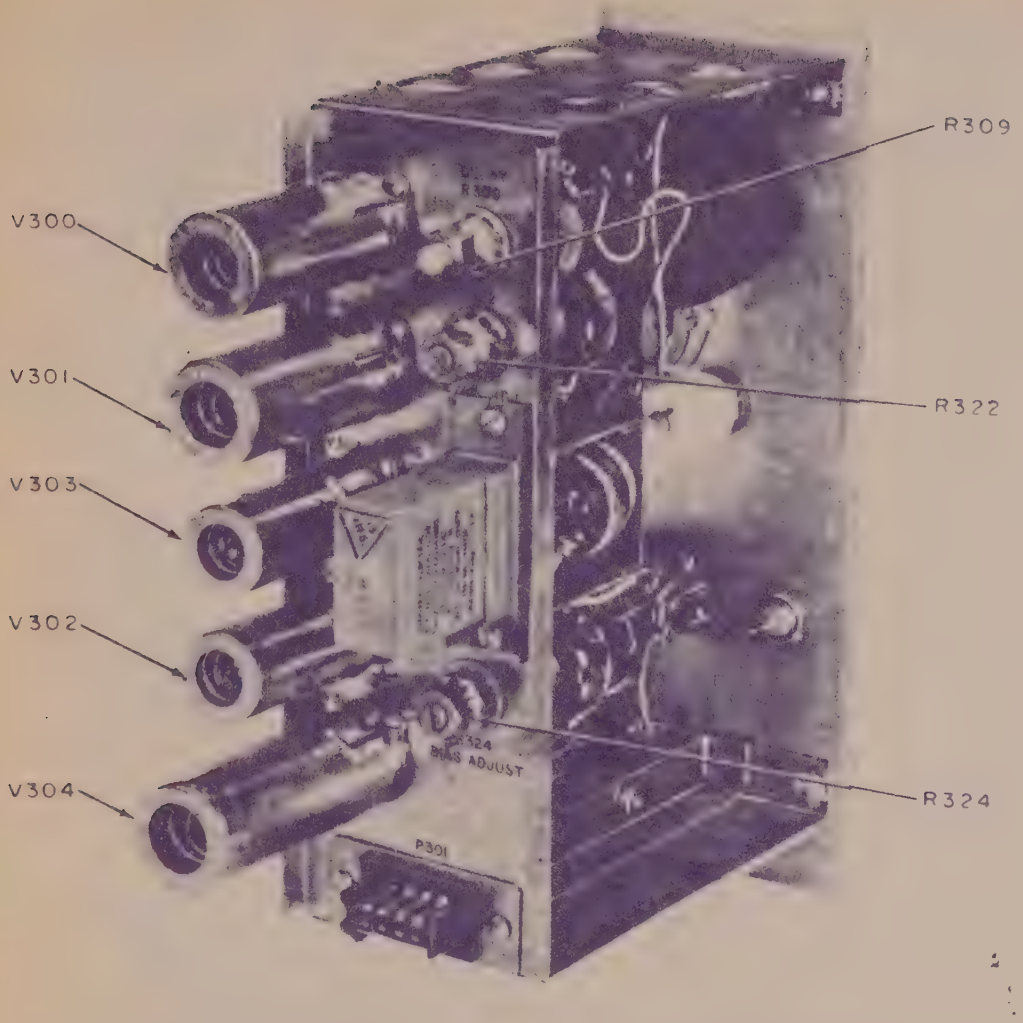


Figure 3. Typical Plug-in Pulse and Delay Generator Unit, Rear View

TABLE 4-2. TROUBLE SHOOTING

SYMPTOM	REMEDY
No B+ voltage or ac across primary of T101.	Check K101 for open contacts and thermal element.
One pulse not stable.	Check adjustment of BIAS ADJUST potentiometer R324 in that particular pulser.
One pulse drops out at minimum delay.	Check adjustment of DELAY potentiometer R309 in that pulser.
Maximum delay of all pulsers is not 32 usecs.	Check adjustment of DELAY RANGE capacitor C209 in main chassis.
All pulses and repetition rate unstable.	Check voltage and regulation of B+.
Trigger output unstable.	Check adjustment of TRIGGER BIAS ADJUST R121.
All pulses unstable (but square wave is stable).	Check stability of 40 usec gate. Check adjustment of 40 usec GATE ADJUST R221.

4-3. TESTS, CHECKS AND ADJUSTMENTS

a. General.

(1) While extraordinary care has been taken in the design and manufacture of the Polarad Model MP-1A Multipulse Generator, it is possible that after a period of considerable time, the unit may require checking and servicing. Unnecessary adjustments of the calibrated modulator circuit should not be made, since these changes may result in a loss of accuracy.

(2) An understanding of the theory of operation, located in Section 2 of this handbook, and careful reference to the tables and schematic in this handbook will prove helpful in locating and correcting any defect which may occur.

WARNING

The operation of this equipment involves the use of high voltages which are dangerous to life. Unless absolutely necessary, do not service or test equipment when operating power is applied. Use extreme caution in making all voltage checks. Remove power and allow capacitors to discharge before touching them. Do not touch vacuum tubes until they have cooled, or severe burns may result.

b. Adjustment and Alignment Procedure.

NOTE

Before making any adjustments, check the MP-1A power supply. A voltmeter indication of plus 225 volts (by adjusting R115) from C102 to ground should be obtained. A voltmeter indication of minus 87 volts from pins 2, 4 or 7 of tube V107 to ground, should be obtained. If these meter indications are obtained, the unit adjustments may be performed, as described below. Never readjust the +225 volt supply after any of the other procedures have been completed, since this will require complete readjustment of all controls which previously have been adjusted.

(1) Connect an oscilloscope and a frequency counter to SQUARE WAVE OUTPUT J103. Apply operating power to the unit. Rotate the SYNC SELECTOR switch to the INT. X10 position. Set the RATE control to maximum clockwise position.

(2) Adjust RATE MAX. and SYMMETRY controls R205 and R241 (chassis adjustments) until frequency counter reads 1,000 cps and a good symmetrical square wave is seen on the crt.

(3) Rotate the SYNC SELECTOR switch to the INT. X1 position. Set the RATE control to minimum counterclockwise position. Adjust the RATE MIN. ADJUST control R203 (chassis adjustment) until frequency counter reads 10 cps.

(4) Recheck adjustments of R205 and R241. Readjust if necessary. Readjustment of R203 and R205 and R241 may be necessary for proper results on both ranges.

(5) Connect the oscilloscope to J109 using a 75-ohm termination. Adjust TRIGGER BIAS ADJUST R121 (chassis adjustment) for maximum output and best stable trigger over the frequency range.

(6) Set the B+ OFF - X1 -X10 DELAY switch to X1 position. Connect the oscilloscope probe to pin No. 2 of V204 (6J6). Turn CALIBRATE ON-OFF switch to ON position. Adjust R221, 40 usec GATE ADJUST, until gate is 40 usecs.

(7) Connect the oscilloscope to J104. Adjust R240, 1 USEC CAL. BIAS control (chassis adjustment) for maximum stable output.

(8) Adjust C219, 1 USEC. CAL. control (chassis adjustment) until the intensity markers are exactly one microsecond apart on the crt and are continuous over a range of 40 microseconds.

(9) Connect the oscilloscope probe to pin No. 2 of V205 (6J6). The sawtooth should be clean and linear.

(10) Set the B+ OFF - X1 - X10 DELAY switch to X1 position. Connect the oscilloscope to J107 using a 100-ohm termination. Turn PULSE WIDTH control to maximum clockwise direction. Set pointer knob to read exactly 2 on panel calibration. Adjust BIAS ADJUST R324 (chassis adjustment) until one pulse appears on the crt (halfway between no pulse and free-running pulse).

(11) Set PULSE DELAY control to minimum delay (2). Adjust the DELAY control R309 (chassis adjustment) until the leading edge of the pulse is 2.0 microseconds from zero trigger.

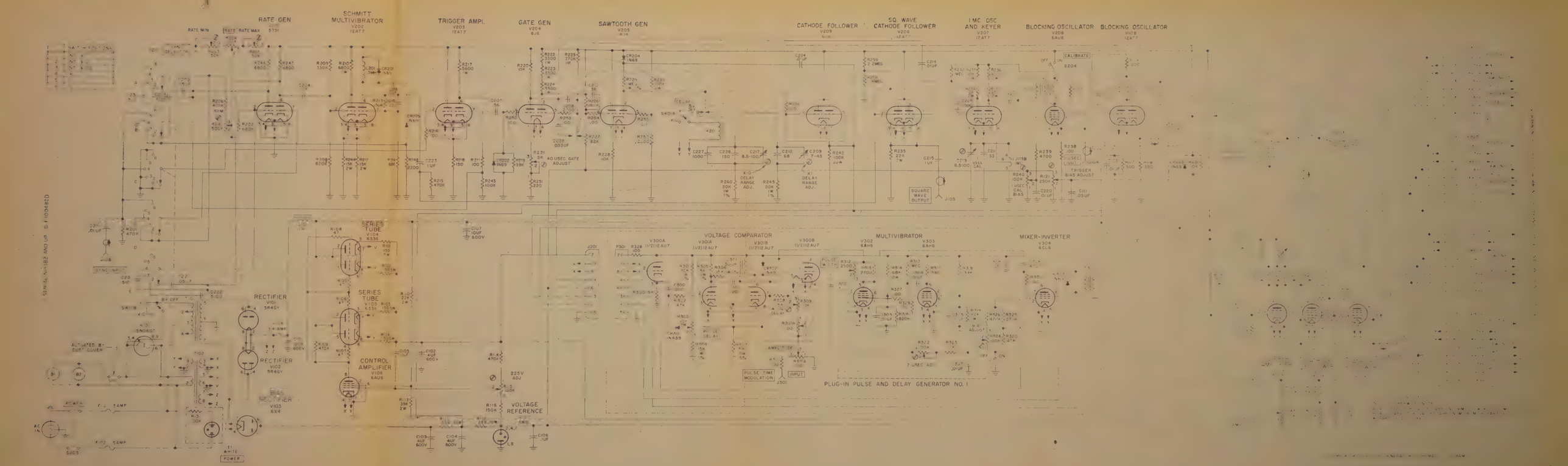
(12) Adjust 2 USEC ADJ. control R322 (chassis adjustment) until the pulse width is exactly 2.0 microseconds.

(13) Turn on all plug-in pulse units. Turn the DELAY control to its maximum position (32). Adjust the DELAY RANGE trimmer capacitor C209 (chassis adjustment) until the leading edges of the pulses are delayed 32 microseconds.

(14) Set the B+ OFF - X1 - X10 DELAY switch to X10 position. Adjust the X10 DELAY RANGE ADJ. C217 (chassis adjustment) for a 320 microsecond delay.

(15) Adjust L102 for a minimum overshoot on pulses.

(16) The Modulator Unit is now calibrated and adjusted.


RATE GEN
SCHMITT MULTIVIBRATOR
V202 12AT7
TRIGGER AMPL
V203 12AT7
GATE GEN
V204 6J6
SAWTOOTH GEN
V205
CATHODE FOLLOWER
V209
SQ. WAVE CATHODE FOLLOWER
V206 12AT7
IMC OSC AND KEYER
V207 12AT7
BLOCKING OSCILLATOR
V208 6AU6
BLOCKING OSCILLATOR
V108 12AT7
RATE MIN
RATE MAX
40 USEC GATE ADJUST
X10 DELAY RANGE ADJ.
X1 DELAY RANGE ADJ.
SQUARE WAVE OUTPUT
CALIBRATE
TRIGGER BIAS ADJUST
SERIES TUBE
V104 6336
SERIES TUBE
V105 6336
CONTROL AMPLIFIER
V106 6AU6
RECTIFIER
V101 5R4GY
RECTIFIER
V102 5R4GY
RECTIFIER
V103 6X4
VOLTAGE REFERENCE
VOLTAGE COMPARATOR
V300A (1/2)12AU7
V301A (1/2)12AU7
V301B (1/2)12AU7
V300B (1/2)12AU7
MULTIVIBRATOR
V302 6AH6
V303 6AH6
MIXER-INVERTER
V304 6CL6
PULSE TIME MODULATION
INPUT
PLUG-IN PULSE AND DELAY GENERATOR NO. 1
POWER
SERIAL NUMBERS 1-182 AND UP E-F 1004820

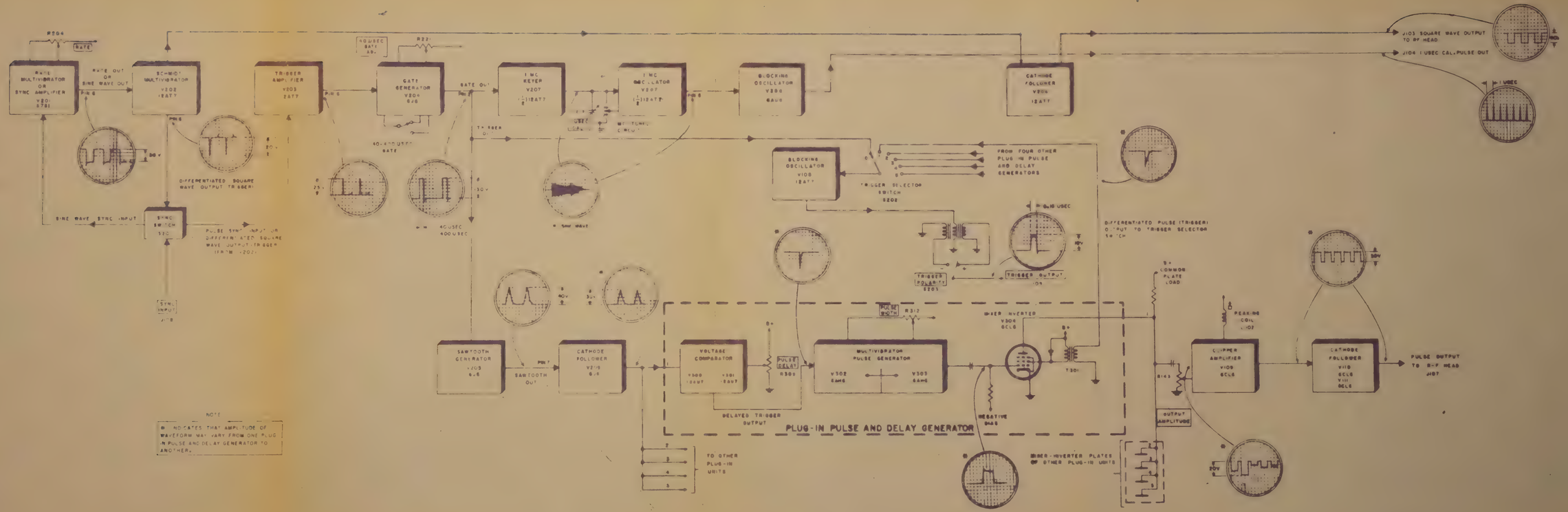


Figure 5. Multipulse Generator, Servicing Block Diagram

SECTION 5

PARTS LIST

5-1. INTRODUCTION

The parts included below are non-standard parts utilized in this equipment, and may be purchased from Polarad Electronics Corporation. Always order by Reference Symbol and Part Number.

Reference Symbol	Description	Polarad Part No.
B1, B2	Motor, Blower	BK5565
CR201	Diode, crystal rectifier	1N69
CR301	Diode, crystal rectifier	1N459
I 1	Lamp indicator	NE51
K101	Relay, time delay	AK5187
K201	Relay, armature	KR11A
L101	Choke, power supply	T167
L102	Choke, radio frequency	AP22318
L201	Choke, radio frequency	AP22580
L203	Coil, oscillator	BP21511
L301	Coil, radio frequency	AP21510
R115	Resistor, variable, 225 v adjustment	RV4ATSD104A
R121	Resistor, variable, bias adjustment	RV4ATSD254A
R203	Resistor, variable, rate adjustment	RV4ATSD255D
R204	Resistor, variable, rate adjustment	RV4ATRD253A
R240	Resistor, variable	RV4ATSD104A
R303	Resistor, variable, delay adjustment	10,000 C2
R309	Resistor, variable, delay	RV4ATFD101A-A111133
R310	Resistor, variable, amplitude control	RV4ATFD101A-
S201	Switch, rotary, sync selector	2023
S202	Switch, rotary, trigger selector	2503
S203	Switch, toggle, trigger polarity	8816
S204	Switch, toggle, calibration	8803
S205	Switch, rotary	PA2002
T101	Transformer, power, step-up	BP21763
T102	Transformer, filament, step-down	BP21764
T103	Transformer, pulse	
T301	Transformer, pulse	ASK2268
V101	Electron tube	5R4GY
V102	Electron tube	5R4GY
V103	Electron tube	6X4
V104	Electron tube	6336
V105	Electron tube	6336
V106	Electron tube	6AU6
V107	Electron tube	5651
V108	Electron tube	12AT7
V109	Electron tube	6CL6
V204	Electron tube	6J6
V301	Electron tube	12AU7
V302	Electron tube	6AH6
W101	Cable assembly	A102082
W102	Cable assembly, power	A28035
XF101	Fuseholder	340049
XI 101	Lampholder	95408-935

Reference Symbol	Description	Polarad Part No.
	Dial, pulse delay	8J5488
	Fan, blower	CK5566-5
	Knob, amplitude	AP22084-1
	Knob, delay	AP22084-1
	Knob, output amplitude	A22084-2
	Knob, pulse time modulator	AP22083
	Knob, rate control	AP22083
	Knob, sync selector	AP22084-1
	Knob, trigger selector	AP22084-1
	Pulse, generator unit	DP22009
Interlock	Switch, tuning	3AC6

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

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510 S. Mathilda Avenue
Sunnyvale, Calif.
Regent 6-6733

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Industrial Associated Electronics
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Fort Worth, Texas
Jefferson 1-1132
Jefferson 5-2056

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Decatur 2-8000

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Atlanta 5, Ga.
Trinity 3020

Murphy and Cota
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Winston-Salem, N.C.
Winston-Salem 4-0750

Murphy and Cota
1220 Edgewater Drive
Orlando, Fla.
Garden 4-2167

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99 Elm Street
West Newton, Mass.
Bigelow 4-4832

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Polarad Electronics Corporation
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Long Island City 1, N. Y.
EXeter 2-4500

Alfred A. Goldberg
Richard J. Sheloff

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Glenview 8-2358

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1468 Old York Road
Abington, Pa.
TUrner 4-7200

Eastern Associates
5612 Belleville Ave.
Baltimore 7, Maryland
Liberty 2-1011

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Volunteer 3-3661

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Wichita, Kansas
Jackson 4-0111
Jackson 4-8628

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Cedar Rapids, Iowa
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Skyline 6-1580
Skyline 6-1589

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Portland, Oregon
Belmont 4-9375

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Arnprior 400

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